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## BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

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## TITLE

DECLINE OF THE BLACKHEADED BUDWORM IN THE  
OLYMPIC PENINSULA REGION IN 1945

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INTRODUCTION

A serious epidemic of the black-headed budworm, Alercis (Peronea) variana Fernald became evident during 1944 on the Olympic Peninsula and along the coastal areas of western Washington. The first indication of an outbreak in hemlock stands was reported by the National Park Service from the Sol Duc Hot Springs and Olympic Hot Springs areas of Olympic National Park in August, 1943. Specimens of the defoliator sent to Portland, Oregon by Assistant Forester Reino Sarlin at that time were identified by R. L. Furniss as the black-headed budworm.

A general reconnaissance survey of accessible areas in the northern and western parts of Olympic Peninsula to determine the extent and seriousness of infestations was made by Furniss late in July, 1944. In a memorandum of conditions found Furniss 1/ stated: "Very heavy defoliation, particularly of understory trees, was noted around both the Olympic Hot Springs and Sole-duck Hot Springs". Moderate to heavy infestations were found along slopes to the west of Elwha River, and in the vicinity of Lake Southerland, and Lake Crescent. Lighter infestations were reported along the west coastal areas from Sappho southward.

A more detailed survey of conditions was made from August 15 to 22, 1944 by R. L. Furniss, both from the ground and from the air. He was aided by representatives of the U. S. Forest Service, State Division of Forestry, Crown Zellerbach Corporation, and Rayonier Incorporated. Adverse flying weather prevented full coverage of all areas by air, but considerable information on the extensiveness of the infestation was obtained. This was supplemented by ground observations from roads, trails, and high observation points.

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1/ Furniss, R. L. Memorandum Regarding an Outbreak of the Black-headed Budworm Peronea variana Fern. In Olympic National Park and Adjoining Area. Portland 5, Oregon, July 29, 1944.

A report of conditions found was issued by Furniss 2/on August 31, 1944 in which he stated: "The indications are that the budworm is abnormally abundant wherever hemlock occurs in the northern and western parts of the Olympic Peninsula and also southward along the coast to the Columbia River. Reports of the National Park Service indicate that it is likewise prevalent along the eastern slopes of the Olympics at least as far south as Lake Cushman."

The character of the infestation and its extensiveness indicated continued epidemic activity in 1945. This was indicated particularly by the presence of countless numbers of adult moths in flight everywhere throughout hemlock stands at the time of the August examinations. Adults in such numbers were expected to lay eggs in epidemic numbers. Local residents reported also that later on in the season the edges of lake shores at Lake Crescent and Lake Southerland were made unpleasant by the decaying bodies of countless thousands of dead moths which had fallen into the water.

The seriousness of the epidemic which threatened to continue for another year caused considerable interest and concern to timber owners. The lack of adequate information on the habits or cycle of the budworm, biological control factors, and artificial control measures indicated need for studies as soon as feasible in the spring of 1945. This study was undertaken by the writer under assignment from the Berkeley, California laboratory of the Bureau of Entomology and Plant Quarantine. The study was closed after one month of investigation when it was determined conclusively that epidemic conditions failed to develop. Instead the number of eggs and larvae found indicated a drop to such a low point that no further damage could be anticipated.

#### AREAS VISITED AND CONDITIONS FOUND

Gray Wolf River. A reconnaissance trip to the Three Forks area in Olympic National Park 20 miles southwest of Sequim, Washington in company with Chief Ranger Augustine revealed evidence of epidemic conditions in 1944. Hemlock (Tsuga heterophylla) in the vicinity of the junction of Grand, Cameron, and Graywolf Rivers were heavily defoliated. Light defoliations were evident also in Pacific silver fir (Abies amabilis) and Douglas fir (Pseudotsuga taxifolia.) Evidence of continued activity in 1945 was completely lacking. No eggs were found even from the most heavily defoliated trees.

Sol Duc River. The areas bordering the Sol Duc River and tributaries were visited several times between May 29 and June 22. Virgin hemlock stands along the Sol Duc Hot Springs road were very heavily defoliated in 1944, amounting to 85 percent in many of the larger trees. Understory hemlock were most heavily defoliated, particularly in the tops, which in many instances amounted to nearly 100 percent.

2/ Furniss, R. L. Observations on an Outbreak of the Blackheaded Budworm in the State of Washington-Season of 1944. Portland, Ore. Aug. 31, 1944.

Evidence of continued epidemic budworm activity in 1945 was completely lacking. Intensive counts of eggs revealed a great scarcity. For example, the maximum number of eggs found was 55 in 3 hours of continuous searching. The average number found amounted to 10 eggs per hour. The same lack of eggs was found in the tops of large hemlocks freshly felled by loggers in a nearby area.

North Point Area. Second growth hemlock and Pacific silver fir, mainly of pole-size, extending along the North Point road to Kloshe Nanich Lookout between 5 and 7 miles north of Snider Ranger Station were very heavily defoliated in 1944. Affected trees, particularly the hemlocks, varied in the extent of defoliation from 25 to 95 percent. The infestations were concentrated particularly in the tops of these trees which in some cases were top-killed. The top-killing and general defoliation was confined principally to the hemlocks; next heaviest defoliations were among the Pacific silver fir. A few young Douglas firs in this area were lightly affected. Egg counts from numerous hemlock and balsam fir branches and from 2 complete trees revealed no evidence of a continued heavy infestation in 1945. The trees (one hemlock and one Pacific silver fir, each 20 feet high) revealed a total number of 82 eggs after 8 hours examination.

Elwha River. Virgin hemlock and Pacific silver fir stands, particularly in the vicinity of Olympic Hot Springs were moderately to heavily defoliated in 1944. Lighter infestations extended on slopes east of Lake Mills. Egg counts from 5 large branches taken from an affected Pacific silver fir near Olympic Hot Springs revealed 8 eggs, a number much too insignificant to indicate continued heavy 1945 activity.

Lake Southerland, Lake Crescent Areas. Black-headed budworm infestations in second growth hemlock stands on slopes to the south of Lake Southerland, and in virgin hemlock stands on slopes to the south of Lake Crescent were light to moderate in 1944. Egg counts from the Lake Crescent areas indicated the same downward trend as elsewhere. Counts from 4 large branches from LaPoel at Crescent Lake, for example, revealed 4 eggs.

Clallam Bay Area. Virgin hemlock areas lying immediately southward and westward from Clallam Bay were moderately to heavily defoliated during 1944. In addition to the budworm this defoliation appeared to be partly the result of a tussock moth, probably the western rusty tussock moth, Notolophus antiqua badia. Numerous tussock moth cocoons with egg masses attached were noted among the branches of defoliated trees which had been felled during May, 1945 by loggers. The scarcity of budworm eggs here as in all areas examined indicated no continuance of heavy defoliation by this insect in 1945. A total number of 6 eggs from 7 large branches was counted.

Neah Bay Area. Virgin hemlock stands south-east and west of Neah Bay were moderately infested by the black-headed budworm in 1944. Evidence of continued activity in 1945 was completely lacking. No eggs were found as a result of examinations made on a large number of branches from this area.

## REASONS FOR THE DECLINE

The factors responsible for the sudden decline in activity of the black-headed budworm simultaneously in all areas in 1945 even though in many instances they were widely separated from each other is not fully understood. Most probably it is due to the number of parasites of eggs, larvae, and pupae which built up during the epidemic, and to a wilt disease which affects the larvae, pupae and adults.

Considerable information on the parasites and disease of the budworm was obtained by Prebble and Graham 3/ from their studies of outbreaks of this insect since 1940 on Vancouver Island and the mainland of British Columbia. They state; "The parasitic enemies of the budworm in the coast district of British Columbia include about forty different species." They have found in addition that: "One of the most effective natural control factors of the black-headed budworm is a wilt disease of the larvae and pupae", and are convinced that the disease was primarily responsible for the sudden decline of infestations in several areas studied.

In the absence of sufficient basis for conclusions as to the causes of the decline of the Olympic outbreak, the findings in British Columbia provide a satisfactory explanation. With the epidemic now subsided to a very low point it is obviously impossible to secure more than a meagre amount of information on the biology of the budworm or the factors responsible for its decline from the Olympic areas. This point cannot be answered satisfactorily until another outbreak is discovered and studied from incipency.

The rise and decline of the 1928-1931 epidemic from which Keen 4/ obtained information is the only budworm outbreak of which we have a record on the Olympic Peninsula. Thus there is indicated from the period between that epidemic and the current (1942-1944) outbreak, that the budworm may remain obscure for another decade or longer.

## EFFECT OF BUDWORM OUTBREAK ON TIMBERED AREAS

Evidence of permanent injury to hemlock stands during the current budworm epidemic is negligible. Some injury resulted from the heaviest defoliations in the Sol Duc Hot Springs, Olympic Hot Springs, and North Point areas, but with the exception of some top-killing and light killing of twig ends, the affected trees in all instances were able to leaf out again in 1945 to such an extent that the 1944 defoliation was obscured.

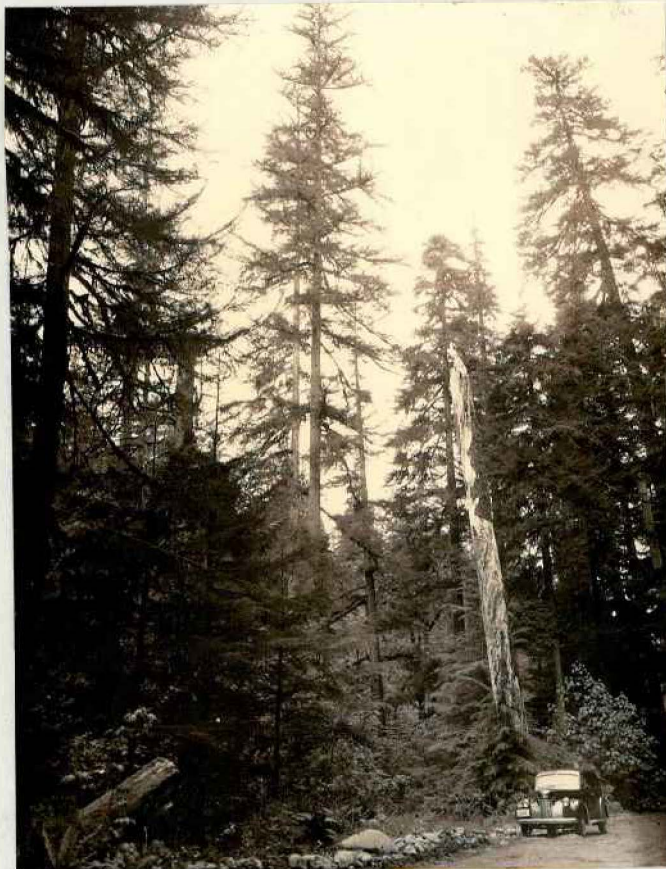
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- 3/ Prebble, M. L. and Graham, K. 1945. The Current Outbreak of defoliating Insects in Coast Hemlock Forests of British Columbia. Part II Factors of Natural Control. British Columbia Lumberman, March, 1945.
- 4/ Keen, F. P. 1939 "Insect Enemies of Western Forests" U.S.D.A. Misc. Pub. No. 273.

A measure of the amount of injury caused was determined from 3 sample plots composed of 50 trees each. On two of these plots established on the North Point road where defoliation in second growth hemlock and balsam fir was very heavy in 1944, top-killing amounted to 38 percent among the hemlock and 6 percent among the fir trees. The amount of top-kill varied from 1 to 10 feet of the top, and averaged less than 5 feet. In the areas most heavily affected along the Sol Duc River, top-killing amounted to 38 percent of the number of trees recorded, all of them younger trees; no top-killing was observed in mature trees. The killing of twig ends among trees in all plots was negligible, averaging less than 5 percent.

No permanent damage to the stands of hemlock is anticipated on the basis of observed injury and recovery. There can be no doubt that a temporary retardation in growth rate will follow for a period of one or two years among trees most heavily affected, but full recovery after that is practically assured, even among trees in which 75 percent or more of the foliage was destroyed. Top-killed young trees will probably remain disfigured for a period of 2 to 5 years, or until new leaders are established, but it is not anticipated that many, if any, of these trees will die from the effects of defoliation alone. This condition would doubtless have changed appreciably if the epidemic had continued for another year.

#### RECOMMENDATIONS

Periodic examinations, at least every 2 or 3 years should be made in the Olympic areas to determine the status and trend of black-headed budworm development. If the trend is upward, studies should be undertaken, if possible, to secure much-needed information on the biological aspects of outbreaks, and also the factors which tend to control them. The possibilities of controlling outbreaks by artificial means should also be investigated.



Photograph No. 1 Heavy defoliation caused by the black-headed budworm of mature hemlocks along the Sol Duc River. The trees in this photograph lost approximately 75 percent of their foliage during the 1944 epidemic.



Photograph No. 2. Very heavy defoliation of pole-size hemlocks along North Point road 6 miles north of Snider Ranger Station. Top-killing of these young trees amounted to about 38 percent in areas most seriously defoliated in 1944.



Photograph No. 3. Young Pacific silver fir heavily defoliated in the North Point defoliation area. Some of these trees lost over 75 percent of their foliage in 1944.